$\Delta(1950)\ 7/2^+$

$I(J^P) = \frac{3}{2}(\frac{7}{2}^+)$ Status: ∗∗∗∗

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics **C38** 070001 (2014).

Δ(1950) POLE POSITION

REAL PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1870 to 1890 (≈ 1880) OUR ESTIMATE				
1888± 4	SOKHOYAN	15A	DPWA	Multichannel
1877± 2±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
1876	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
1878	HOEHLER	93	ARGD	$\pi N \to \pi N$
1890±15	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1888± 4	GUTZ	14	DPWA	Multichannel
1890± 4	ANISOVICH	12A	DPWA	Multichannel
1871	SHRESTHA	12A	DPWA	Multichannel
1910	VRANA	00	DPWA	Multichannel

−2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
220 to 260 (≈ 240) OUR ESTIMATE				
245± 8	SOKHOYAN	15A	DPWA	Multichannel
223± 4±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
227	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
230	HOEHLER	93	ARGD	$\pi N \to \pi N$
260±40	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
245± 8	GUTZ	14	DPWA	Multichannel
243± 8	ANISOVICH	12A	DPWA	Multichannel
220	SHRESTHA	12A	DPWA	Multichannel
230	VRANA	00	DPWA	Multichannel

Δ(1950) ELASTIC POLE RESIDUE

MODULUS |r|

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
44 to 60 (≈ 52) OUR ESTIMATE				
58±2	SOKHOYAN	15A	DPWA	Multichannel
44±1	[1] SVARC	14	L+P	$\pi N \to \pi N$
53	ARNDT	06	DPWA	$\pi N \to \pi N$, ηN
47	HOEHLER	93	ARGD	$\pi N \to \pi N$
50±7	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
58±2	GUTZ	14	DPWA	Multichannel
58±2	ANISOVICH	12A	DPWA	Multichannel

PHASE θ

VALUE (°)		DOCUMENT ID		TECN	COMMENT
−24 to −40 (≈ − 32) OUR ESTIMATE					
−24±3		SOKHOYAN	15A	DPWA	Multichannel
−39±1±1	[1]	SVARC	14	L+P	$\pi N \rightarrow \pi N$
−31		ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
−32		HOEHLER	93	ARGD	$\pi N \rightarrow \pi N$
−33±8		CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−24±3		GUTZ	14	DPWA	Multichannel
−24±3		ANISOVICH	12A	DPWA	Multichannel

Δ(1950) INELASTIC POLE RESIDUE

The "normalized residue" is the residue divided by $\Gamma_{pole}/2$.

Normalized residue in $N\pi \rightarrow \Delta(1950) \rightarrow \Sigma K$

MODULUS (%)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
5±1	−65 ± 25	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1950) \rightarrow \Delta\pi$, F-wave

MODULUS (%)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
12±4	undefined	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
12±4	12 ± 10	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1950) \rightarrow \Delta(1232)\eta$

MODULUS (%)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
3.5±0.5	90 ± 25	GUTZ	14	DPWA	Multichannel

Δ(1950) BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1915 to 1950 (≈ 1930) OUR ESTIMATE				
1917 ± 4	SOKHOYAN	15A	DPWA	Multichannel
1921.3± 0.2	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
1950 ±15	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
1913 ± 8	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1917 ± 4	GUTZ	14	DPWA	Multichannel
1915 ± 6	ANISOVICH	12A	DPWA	Multichannel
1918 ± 1	SHRESTHA	12A	DPWA	Multichannel
1936 ± 5	VRANA	00	DPWA	Multichannel

$\Delta(1950)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
235 to 335 (≈ 285) OUR ESTIMATE				
251 $\pm$ 8	SOKHOYAN	15A	DPWA	Multichannel
271.1 $\pm$ 1.1	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
340 $\pm$50	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
224 $\pm$10	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
251 $\pm$ 8	GUTZ	14	DPWA	Multichannel
246 $\pm$10	ANISOVICH	12A	DPWA	Multichannel
259 $\pm$ 4	SHRESTHA	12A	DPWA	Multichannel
245 $\pm$12	VRANA	00	DPWA	Multichannel

$\Delta(1950)$ DECAY MODES

The following branching fractions are our estimates, not fits or averages.

	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\pi$	35–45 %
Γ_2	ΣK	0.3–0.5 %
Γ_3	$N\pi\pi$	
Γ_4	$\Delta(1232)\pi$, F-wave	1–9 %
Γ_5	$N(1680)\pi$, P-wave	3–9 %
Γ_6	$\Delta(1232)\eta$	< 1 %

$\Delta(1950)$ BRANCHING RATIOS

$\Gamma(N\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
35 to 45 OUR ESTIMATE				
46 $\pm$2	SOKHOYAN	15A	DPWA	Multichannel
47.1 $\pm$0.1	ARNDT	06	DPWA	$\pi N \rightarrow \pi N$, ηN
39 $\pm$4	CUTKOSKY	80	IPWA	$\pi N \rightarrow \pi N$
38 $\pm$2	HOEHLER	79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
46 $\pm$2	GUTZ	14	DPWA	Multichannel
45 $\pm$2	ANISOVICH	12A	DPWA	Multichannel
45.6 $\pm$0.4	SHRESTHA	12A	DPWA	Multichannel
44 $\pm$1	VRANA	00	DPWA	Multichannel

$\Gamma(\Sigma K)/\Gamma_{total}$ — Γ_2/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
0.4 $\pm$0.1	ANISOVICH	12A	DPWA	Multichannel

$\Gamma(\Delta(1232)\pi\,,\,F\text{-wave})/\Gamma_{total}$ Γ_4/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
5 ±4	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.8±1.4	ANISOVICH	12A	DPWA	Multichannel
8 ±1	SHRESTHA	12A	DPWA	Multichannel
36 ±1	VRANA	00	DPWA	Multichannel

$\Gamma(N(1680)\pi\,,\,P\text{-wave})/\Gamma_{total}$ Γ_5/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
6±3	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(\Delta(1232)\eta)/\Gamma_{total}$ Γ_6/Γ

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<1	GUTZ	14	DPWA	Multichannel

Δ(1950) PHOTON DECAY AMPLITUDES AT THE POLE

$\Delta(1950) \to N\gamma$, helicity-1/2 amplitude $A_{1/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
−0.067±0.004	−10 ± 5	SOKHOYAN	15A	DPWA	Multichannel
−0.071±0.004	-14^{+2}_{-4}	ROENCHEN	14	DPWA	

$\Delta(1950) \to N\gamma$, helicity-3/2 amplitude $A_{3/2}$

MODULUS (GeV$^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
−0.095±0.004	−10 ± 5	SOKHOYAN	15A	DPWA	Multichannel
$-0.089^{+0.008}_{-0.007}$	-10^{+3}_{-1}	ROENCHEN	14	DPWA	

Δ(1950) BREIT-WIGNER PHOTON DECAY AMPLITUDES

$\Delta(1950) \to N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.067±0.005	SOKHOYAN	15A	DPWA	Multichannel
−0.083±0.004	WORKMAN	12A	DPWA	$\gamma N \to N\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.067±0.005	GUTZ	14	DPWA	Multichannel
−0.071±0.004	ANISOVICH	12A	DPWA	Multichannel
−0.065±0.001	SHRESTHA	12A	DPWA	Multichannel
−0.094	DRECHSEL	07	DPWA	$\gamma N \to \pi N$

$\Delta(1950) \to N\gamma$, helicity-3/2 amplitude $A_{3/2}$

VALUE (GeV$^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.094±0.004	SOKHOYAN	15A	DPWA	Multichannel
−0.096±0.004	WORKMAN	12A	DPWA	$\gamma N \to N\pi$

• • • We do not use the following data for averages, fits, limits, etc. • • •

-0.094 ± 0.004	GUTZ	14	DPWA	Multichannel
-0.094 ± 0.005	ANISOVICH	12A	DPWA	Multichannel
-0.083 ± 0.001	SHRESTHA	12A	DPWA	Multichannel
-0.121	DRECHSEL	07	DPWA	$\gamma N \to \pi N$

Δ(1950) FOOTNOTES

[1] Fit to the amplitudes of HOEHLER 79.

Δ(1950) REFERENCES

SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan et al.	(CBELSA/TAPS Collab.)
GUTZ	14	EPJ A50 74	E. Gutz et al.	(CBELSA/TAPS Collab.)
PDG	14	CP C38 070001	K. Olive et al.	(PDG Collab.)
ROENCHEN	14	EPJ A50 101	D. Roenchen et al.	
Also		EPJ A51 63 (errat.)	D. Roenchen et al.	
SVARC	14	PR C89 045205	A. Svarc et al.	
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich et al.	(BONN, PNPI)
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)
WORKMAN	12A	PR C86 015202	R. Workman et al.	(GWU)
DRECHSEL	07	EPJ A34 69	D. Drechsel, S.S. Kamalov, L. Tiator	(MAINZ, JINR)
ARNDT	06	PR C74 045205	R.A. Arndt et al.	(GWU)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky et al.	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky et al.	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler et al.	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP